

## CLAIMS

We claim:

- 1 1. An encapsulant composition comprising:
  - 2 a resin material;
  - 3 a flexibilizing agent; and
  - 4 a filler material.
- 1 2. The composition of claim 1 wherein said resin material is  
2 selected from the group consisting of epoxy and cyanate ester  
3 resins.
- 1 3. The composition of claim 2 wherein said resin material is an  
2 epoxy resin and comprises cycloaliphatic epoxides.
- 1 4. The composition of claim 3 wherein said cycloaliphatic  
2 epoxides are derived from unsaturated aromatic hydrocarbon  
3 compounds.
- 1 5. The composition of claim 2 wherein said resin material is an  
2 epoxy resin and comprises glycidyl ethers.

1 6. The composition of claim 2 wherein said resin material is a  
2 cyanate ester resin and comprises at least a di-cyanate ester  
3 resin.

1 7. The composition of claim 2 wherein said resin material  
2 comprises about 20 percent to about 55 percent by weight of said  
3 composition.

1 8. The composition of claim 1 wherein said flexibilizing agent  
2 is selected from the group consisting of polysulfones,  
3 polyetherimide, polyamideimides, polyarylene ethers, polyesters,  
4 polyarylates, polycarbonates, polyurethanes, hydroxy-terminated  
5 polysulfone oligomers, 1,4-butane-diol diglycidyl ethers,  
6 neopentylglycol diglycidyl ether, cyclohexane dimethanol  
7 diglycidyl ether, trimethylol ethane triglycidyl ethers,  
8 dibromoneopentylglycol glycidyl ethers, propoxylated glycerol  
9 polyglycidyl ether, polypropylene glycol glycidyl ether,  
10 polyglycidyl ether of castor oil, dimer acid diglycidyl esters,  
11 resorcinol diglycidyl ether, epoxidized propylene glycol  
12 dioleates, epoxy esters, 1,2-tetradecane oxides, internally  
13 epoxidized 1,3-butadiene homopolymers, diglycidyl ether, glycidyl  
14 glycidate, bis(2,3-epoxy-2-methylpropyl)ether,  
15 polyglycoldiepoxydes, E-caprolactone triol, copolymers of  
16 butadiene and styrene, butyl rubber, neoprene, polysiloxanes,  
17 carboxyl terminated poly n-butylacrylates, maleic anhydride  
18 terminated rubbers, epoxy functionalized rubbers, fluoridized  
19 rubbers, and hydroxylated or carboxylated EPDM rubbers.

1 9. The composition of claim 8 wherein said flexibilizing agent  
2 comprises about 1 percent to about 5 percent by weight of said  
3 composition.

1 10. The composition of claim 1 wherein said filler material is  
2 selected from the group consisting of silica, aluminum oxide,  
3 alumina, aluminum nitride, silicon nitride, silicon carbide,  
4 beryllium oxide, boron nitride, zirconates and diamond powder.

1 11. The composition of claim 10 wherein said filler material is  
2 a zirconate and comprises zirconium tungstate having a negative  
3 expansion property.

1 12. The composition of claim 10 wherein said filler material  
2 comprises about 44 percent to about 75 percent by weight of said  
3 composition.

1 13. The composition of claim 10 wherein said filler material  
2 comprises substantially spherical or spheroidal particles, each  
3 particle having a diameter of less than about 41 microns.

1 14. The composition of claim 13 wherein a portion of each of  
2 said spherical or spheroidal particles includes a layer of  
3 coupling agent positioned thereon.

1 15. The composition of claim 1 further including a catalyst  
2 material.

1 16. The composition of claim 15 wherein said catalyst material  
2 is selected from the group consisting of imidazoles, tertiary  
3 amines, benzyldimethylamine, 1,3-tetramethyl butane diamine, tris  
4 (dimethylaminomethyl) phenol, pyridine, triethylendiamine,  
5 aluminum chloride, boron trifluoride, ferric chloride, titanium  
6 chloride, zinc chloride, sodium acetate, disodium cyanide, sodium  
7 cyanate, potassium thiocyanate, sodium bicarbonate, sodium  
8 boronate, and cobalt, manganese, iron, zinc, or copper  
9 acetylacetonate, octoate, or naphthenates .

1 17. The invention of claim 1 wherein said composition has a  
2 viscosity of about 750 centipoise to about 50,000 centipoise at a  
3 temperature of about 25 degrees Celsius.

1 18. An electronic package comprising:

2 a substrate having an upper surface;

3 a semiconductor chip mounted on a portion of said upper  
4 surface of said substrate and electrically coupled to said  
5 substrate, said semiconductor chip having a bottom surface and at  
6 least one edge surface being substantially perpendicular to said  
7 bottom surface; and

8 a material positioned on at least said portion of said upper  
9 surface of said substrate and against at least a portion of said

10 at least one edge surface of said semiconductor chip, said  
11 material being an encapsulant composition which includes a resin  
12 material, a flexibilizing agent and a filler material.

1 19. The electronic package of claim 18 wherein said substrate  
2 comprises an organic material.

1 20. The electronic package of claim 19 wherein said organic  
2 material includes a resin selected from the group consisting of  
3 epoxies, polyimides, cyanates, fluoropolymers, benzocyclobutenes,  
4 polyphenylenesulfides, polysulfones, polyetherimides,  
5 polyetherketones, polyphenylquinoxalines, polybenzoxalines,  
6 polybenzoxazoles, polyphenylbenzobisthiazoles,  
7 dicyclopentadienes, and halide free resins .

1 21. The electronic package of claim 19 wherein said substrate  
2 further includes a reinforcing material.

1 22. The electronic package of claim 21 wherein said reinforcing  
2 material is selected from the group consisting of organic woven  
3 fibers, organic non-woven fibers, inorganic woven fibers, and  
4 inorganic non-woven fibers.

1 23. The electronic package of claim 18 wherein said substrate  
2 comprises a ceramic material.

1 24. The electronic package of claim 23 wherein said substrate  
2 further includes a layer of glass material therein.

1 25. The electronic package of claim 18 wherein said resin  
2 material is selected from the group consisting of epoxy and  
3 cyanate ester resins.

1 26. The electronic package of claim 25 wherein said resin  
2 material is an epoxy resin and comprises cycloaliphatic epoxides.

1 27. The electronic package of claim 26 wherein said  
2 cycloaliphatic epoxides are derived from unsaturated aromatic  
3 hydrocarbon compounds.

1 28. The electronic package of claim 25 wherein said resin  
2 material is an epoxy resin and comprises glycidyl ethers.

1 29. The electronic package of claim 25 wherein said resin  
2 material is a cyanate ester resin and comprises at least a di-  
3 cyanate ester resin.

1 30. The electronic package of claim 25 wherein said resin  
2 material comprises about 20 percent to about 55 percent by weight  
3 of said composition.

1 31. The electronic package of claim 18 wherein said  
2 flexibilizing agent is selected from the group consisting of  
3 polysulfones, polyetherimide, polyamideimides, polyarylene  
4 ethers, polyesters, polyarylates, polycarbonates, polyurethanes,  
5 hydroxy-terminated polysulfone oligomers, 1,4-butane-diol  
6 diglycidyl ethers, neopentylglycol diglycidyl ether, cyclohexane  
7 dimethanol diglycidyl ether, trimethylol ethane triglycidyl  
8 ethers, dibromoneopentylglycol glycidyl ethers, propoxylated  
9 glycerol polyglycidyl ether, polypropylene glycol glycidyl ether,  
10 polyglycidyl ether of castor oil, dimer acid diglycidyl esters,  
11 resorcinol diglycidyl ether, epoxidized propylene glycol  
12 dioleates, epoxy esters, 1,2-tetradecane oxides, internally  
13 epoxidized 1,3-butadiene homopolymers, diglycidyl ether, glycidyl  
14 glycidate, bis(2,3-epoxy-2-methylpropyl)ether,  
15 polyglycoldiepoxydes, E-caprolactone triol, copolymers of  
16 butadiene and styrene, butyl rubber, neoprene, polysiloxanes,  
17 carboxyl terminated poly n-butylacrylates, maleic anhydride  
18 terminated rubbers, epoxy functionalized rubbers, fluoridized  
19 rubbers, and hydroxylated or carboxylated EPDM rubbers.

1 32. The electronic package of claim 31 wherein said  
2 flexibilizing agent comprises about 1 percent to about 5 percent  
3 by weight of said composition.

1 33. The electronic package of claim 18 wherein said filler  
2 material is selected from the group consisting of silica,  
3 aluminum oxide, alumina, aluminum nitride, silicon nitride,  
4 silicon carbide, beryllium oxide, boron nitride, zirconates, and  
5 diamond powder.

1 34. The electronic package of claim 33 wherein said filler  
2 material is a zirconate and comprises zirconium tungstate having  
3 a negative expansion property.

1 35. The electronic package of claim 33 wherein said filler  
2 material comprises about 44 percent to about 75 percent by weight  
3 of said composition.

1 36. The electronic package of claim 33 wherein said filler  
2 material comprises substantially spherical or spheroidal  
3 particles, each particle having a diameter of less than about 41  
4 microns.

1 37. The electronic package of claim 36 wherein a portion of each  
2 of said spherical or spheroidal particles includes a layer of  
3 coupling agent positioned thereon.

1 38. The electronic package of claim 18 wherein said composition  
2 further includes a catalyst material.

1 39. The electronic package of claim 38 wherein said catalyst  
2 material is selected from the group consisting of imidazoles,  
3 tertiary amines, benzyldimethylamine, 1,3-tetramethyl butane  
4 diamine, tris (dimethylaminomethyl) phenol, pyridine,  
5 triethylendiamine, aluminum chloride, boron trifluoride, ferric  
6 chloride, titanium chloride, zinc chloride, sodium acetate,  
7 disodium cyanide, sodium cyanate, potassium thiocyanate, sodium



8 bicarbonate, sodium boronate, and cobalt, manganese, iron, zinc,  
9 or copper acetylacetonate, octoate, or naphthenates.

1 40. The invention of claim 18 wherein said composition has a  
2 viscosity of about 750 centipoise to about 50,000 centipoise at a  
3 temperature of about 25 degrees Celsius.

1 41. A method of making an encapsulant composition, the method  
2 comprising the steps of:

3 providing a first quantity of resin material;

4 adding to said first quantity of resin material a second  
5 quantity of flexibilizing agent;

6 adding to said first quantity of resin material a third  
7 quantity of filler material; and

8 blending said resin material.

1 42. The method of making the composition of claim 41 wherein  
2 said adding a second quantity of flexibilizing agent comprises  
3 homogenizing said flexibilizing agent in said first quantity of  
4 resin material by reacting said resin material and said  
5 flexibilizing agent together at a temperature of greater than  
6 about 100 degrees Celsius.

- 1 43. The method of making the composition of claim 41 wherein
- 2 said step of blending is performed under vacuum.